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STUDY PROJECT

DECISION MAKING AND DECISION SYSTEM TECHNOLOGY

BY

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USAWC MILITARY STUDIES PROGRAM PAPER

DECISION MAKING AND DECISION SYSTEM TECHNOLOGY

AN INDIVIDUAL STUDY PROJECT

by

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ABSTRACT

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This paper provides an overview of the decision-making process and its application and implications for the senior military leader. Quantitative and qualitative aspects of decision making are reviewed, and the contributions of computer technology to decision making presented. The paper concludes with a discussion of wargaming as a valuable tool for training decision makers and exploring defense issues.

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INTRODUCTION

The rarest gift that God bestows on man is the capacity for decision

—Dean Acheson[1]

Decision making is becoming increasingly complex in our radically transformed "new world." The past few years have brought dramatic developments in the international environment. During most of the forty-odd years since World War II we had a fairly clear notion of the challenges to our national security interests. We could focus our foreign policy on a principally bipolar world and concentrate our national security strategy on the Soviet political and military threat. The recent collapse of Soviet domination in Eastern Europe dramatically changed the political, economic, and military dimensions of the threat. But victory in the Cold War, however welcome, has complicated, rather than simplified, strategic decision making in the U.S. defense establishment. The next few years have extraordinary potential for being challenging and hazardous to the national interests of the United States and the stability of world peace.

Many hotly contested issues that guided our strategic thinking for four decades are now less significant, or totally irrelevant. A new array of momentous questions now confronts our senior leadership:

> What is the nature of the post-Cold War world? What forms of power will be important? What will be the prevailing patterns of cleavage and alliance? What is the American role in this new world? What are America's interests and from whence will those interests be threatened? What policies should the United States follow in order to protect its interests? What military forces and other capabilities will be required to carry out these policies?[2]

Another consequence of the Cold War victory will further complicate the task of decision makers. After fighting and winning what were, in effect, three world wars in

seventy-five years, the American public is expecting to reap the "peace dividend" of its triumphs. Many Americans view the emerging world order as a safer place for U.S. interests--one which will allow the nation to make significant reductions in the size of its military force and defense budget. Lacking a "clear and present danger" to the national security of the United States, American legislators are turning their attention to domestic issues and finding diverse problems to compete more than ever with defense expenditures. Consequently, the defense share of the federal budget is at its lowest point in almost fifty years, and it is likely to go lower yet.

Given this environment of uncertain threat, and the fiscal reality that we have never had--and most likely never will have--sufficient resources to counter all potential threats simultaneously, the age-old question "How much defense is enough?" is perhaps more daunting now than ever before. Finding the answer to this question will lead the Department of Defense (DoD) through a convoluted maze of cascading, interrelated decisions. Changing the roles and missions of the services will influence force structure, which in turn affects weapons acquisitions and base closures, with rippling effects on manpower needs, which drive training requirements . . and so on.

Now, perhaps more than ever, it is essential that defense executives are competent decision makers. It is they who collectively provide the vision and guidance to bring together the resources and operating principles to meet the current and future challenges to our national security.

This paper provides an overview of the decision-making process and its application and implications for the senior military leader.

DECISIONS AND DECISION MAKING

> *Decision making is only one of the tasks of an executive. It usually takes but a small fraction of his time. But to make decisions is the specific executive task. Decision making therefore deserves special treatment in a discussion of the effective executive.*
>
> —*Peter F. Drucker* [3]

Decision making is an integral part of the leadership and management of any kind of organization. More than any other factor, competence in this activity distinguishes the leader/manager from the follower/non-manager. More important, competence as a decision maker distinguishes the *effective* manager from the *ineffective* manager.[4] Of all the managerial functions which executives perform, the act of making a decision is without equal in importance — that is, the act of making the *right* decision about the *right* problem or opportunity. Some have even suggested that the best way to judge the competence of any executive, whether a production foreman or the President of the United States, is by the quality of the decisions made in complex situations when faced with uncertainty.[5]

The term "decision" can be most simply defined as "the result of making a choice." Frank Harrison, the noted academician and management consultant, provides a more complete and scholarly definition of a decision:

> A moment, in an ongoing process of evaluating alternatives for meeting an objective, at which expectations about a particular course of action impel the decision maker to select that course of action most likely to result in attaining the objective.[6]

Definitions of the broader concept of "decision-making" are many and varied. The characteristics common to most definitions are the existence of several alternatives, and the notion that the decision maker's choice involves a comparison of the alternatives

and an evaluation of their outcomes. Department of the Army (DA) Pamphlet 600-80, Executive Leadership, defines decision making as "the exercise of judgment to choose/develop and implement a course of action," and includes it in the broader process of problem solving, which it defines as "first understanding a partially unstructured situation and then developing a course of action."[7]

Like it or not, we all serve as decision makers to some extent, beginning at the lowest level with the often trite and mundane decisions of our daily lives. These decisions are, for the most part, made on the basis of hunches, intuition, or habit. With little or no special training or expertise, we sometimes surprise ourselves by the good judgment we exercise in choosing between the alternatives available to us. But at this level, the ramifications of a poor choice are generally limited in scope and severity. When viewed as part of the accepted risks—the joys and disappointments of everyday life—the outcomes of poor decisions are acceptable.

At the organizational level, however, the importance of decisions increases, and the potential adverse consequences of bad decisions multiply as well, sometimes dramatically. Until recently, "seat-of-the-pants" decision making was often the norm, and some administrators were successful at it. Today, with an ever-expanding knowledge base, global internationalization, and extremely rapid changes in technology, decision makers will find the traditional intuitive approach unworkable for success or survival. In any organization, but particularly the military, the adverse consequences of poor decisions are simply too great. The era of the intuitive decision maker is over.

The good news is that "capable decision makers are made, not born."[8] The decision-making process has been studied and described extensively in recent years, and with diligent effort, any executive can learn it. Given the critical importance of

competence in this endeavor, it is well worth the executive's effort to hone his own decision skills and carefully develop and nurture them in his subordinates.

Every decision we make requires us to think in terms of *objectives*, *alternatives*, and *potential risks*. The choice may be a simple one involving few criteria, made quickly by a single person, or a complex choice involving thousands of criteria and the deliberations of hundreds of people. The dimensions of the decision are immaterial, because the basic process is always the same . . . and the final judgment is always: "This is what ought to be done."[9]

THE DECISION-MAKING PROCESS

If we begin with certainties, we shall end in doubts, but if we begin with doubts, and are patient with them, we shall end in certainties.

—*Francis Bacon*[10]

Decision making is a dynamic, interrelated process. Decisions are made within the framework of a sequence of actions directed toward an objective — and these actions form a continuous and iterative procedure. Figure 1 represents a synthesis of various academic models of the decision-making process.

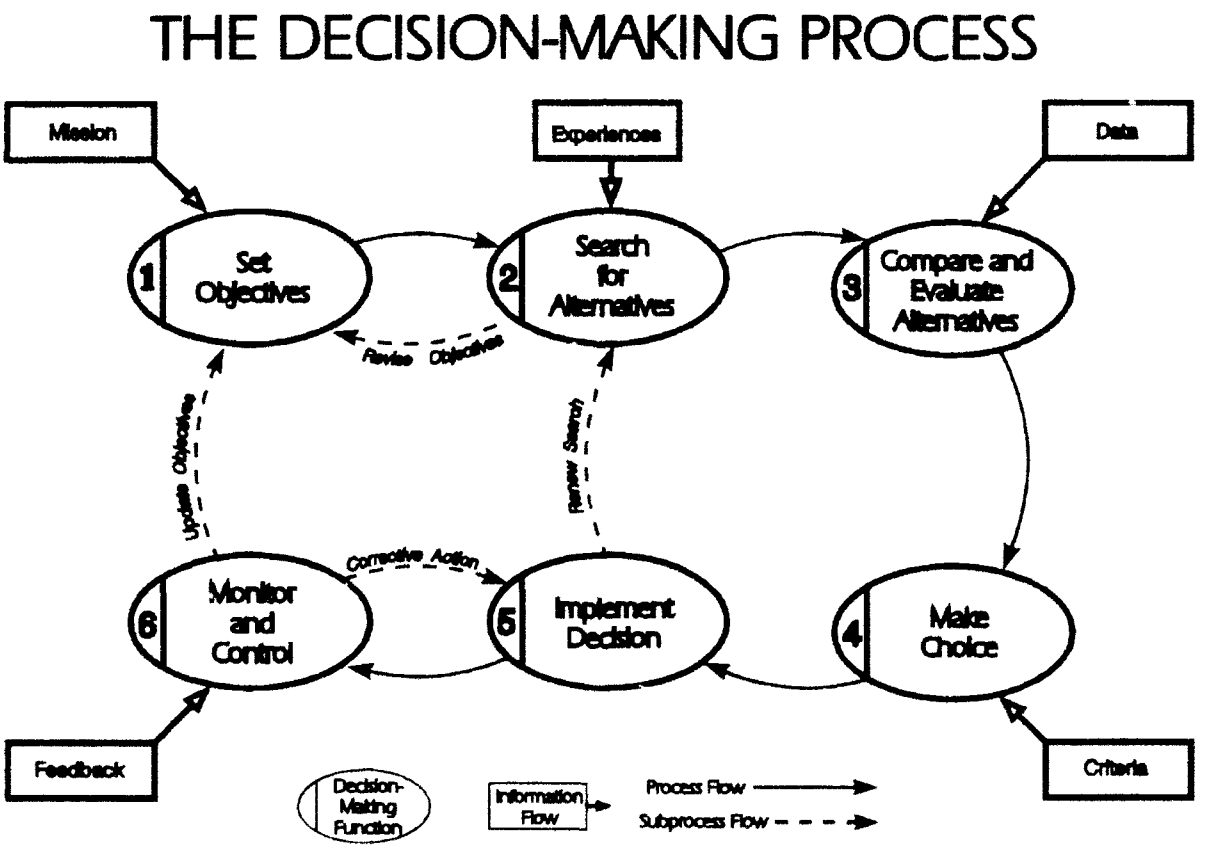

Figure 1.

Figure 1 illustrates the cyclic nature of the decision-making process, the core of which comprises six interrelated decision-making functions.

1. *Set organizational objectives.* The decision maker begins the decision-making process by identifying problems or opportunities and defining objectives for the organization. A single cycle within the process is completed when the original objective is achieved. The next cycle begins when an objective is revised or updated, or a new objective established. A definitive statement of the right objective is paramount. A wrong start will inevitably end with the wrong conclusions and a less than optimum outcome.

2. *The search for alternatives.* Searching for alternatives involves scanning the organization's internal and external environments for relevant information, which is formulated into courses of action deemed likely to fulfill the objectives. At least two courses of action must be available to the decision maker; if there are not, the problem still exists, but there is no decision to make. This is often the most difficult step in the decision-making process. It requires creative, imaginative thinking and is very hard work. Basic human nature is to limit the search and get right to the problem at hand. Many optimal decision opportunities are lost by failure to identify all possible courses of action.

3. *Comparing and evaluating alternatives.* Alternatives are evaluated and compared by formal or informal means, which usually involve analysis, judgment, and/or compromise. Equal or greater attention must be paid to the potentially adverse secondary consequences of each course of action.

4. *Make the best choice.* Choice is the moment in the decision-making process when the decision maker chooses a given course of action from among a set of alternatives. Making the best choice requires the fusion of both quantitative and

qualitative measures of effectiveness or criteria. Choice is also influenced by external influences that are beyond the control of the decision maker. If the optimal alternative has been identified, but still results in a discrepancy between the outcome and the objective, the problem is unsolvable.

5. *Implement the decision.* Implementation causes the chosen alternative to be carried out within the organization. It is that moment in the total decision-making process when choice is transformed from an abstraction into operational reality.

6. *Monitor and control.* This function ensures the decision is implemented as intended, and it results in an outcome that meets the objectives that began the decision-making process. If there is no discrepancy between the outcome and the objective, the problem is solved, and the decision-making process is completed. If, on the other hand, a discrepancy exists, another iteration of the cycle is necessary.

The individual functions of the decision-making process are not separate and distinct entities unto themselves, but are related to each other and to the process as a whole. It is the synergy that arises from this interrelationship of functions that yields much of the dynamism inherent in decision making. That is to say, the interaction of the process as a whole produces a total effect greater than the sum of its individual parts. Four subprocesses support the interrelationship of the individual functions of the decision-making process:

- Revising organizational objectives to match available alternatives.
- Renewing the search to discover new alternatives or to reconsider other existing alternatives in light of new information.

- Taking corrective action as necessary to ensure successful implementation of the decision.
- Updating objectives as necessary based on the success of implementation.

Viewing Figure 1 in the context of operations planning and execution, military members will quickly recognize the elements of the "Commander's Estimate of the Situation" in the first four functions of the decision-making process. The fifth function, *Implementing the Decision*, can be equated to an Operation Order. *Monitoring and Control*, the sixth and final function, is analogous to the "control" aspect of the military notion of "command and control."[12]

Prescriptive vs. Descriptive Decision Making.

The study of decision making can be loosely divided into the fields of prescriptive and descriptive decision-making processes. Prescriptive (also called normative[13]) decision-making processes prescribe how a decision *should* be made. Prescriptive decision scientists are concerned with prescribing methods for making optimal decisions. They might, for example, propose a mathematical model to guide the decision maker to a rational decision.[14]

Descriptive (or behavioral[15]) decision researchers are concerned with the way decisions are *actually* made, rather than how they *should* be made. Descriptive models acknowledge that many, and possibly most, significant decisions are made by using individual judgment rather than by following a defined prescriptive model. [16] The generic

process presented in Figure 1 applies to both prescriptive and descriptive schools of decision making.

Information.

The man who insists upon seeing with perfect clearness before he decides, never decides

—Frederic Amiel [17]

Since no organization is self-contained, or unaffected by its environment, decision making does not operate within an organizational vacuum. Information flows from the environment and influences the decision-making process at many points, as is depicted in Figure 2. Controlling the flow of information is a primary responsibility of the decision maker.

Given the importance of decisions to an organization, and the value of information to decision making, it is logical for decision makers to want "perfect information." Such a state is rare indeed. The reasons are twofold: time and money. Decision making is normally conducted within the constraints of limited time and money. No matter the time devoted, the search for additional knowledge rarely obtains all of the information pertinent to a particular objective. More important, while the costs of additional information rise exponentially, the marginal value of *additional* information declines. At some point the cumulative cost of information outweighs its value and becomes unaffordable. For these reasons, the vast majority of decisions are based on imperfect information.

A decision is said to take place under conditions of certainty when information is "perfect." That is to say, knowledge is such that the decision maker knows the resultant outcome if a particular alternative is chosen. Although not prevalent, certainty does occur.

Highly automated manufacturing processes tend to create an environment of certainty. "Assumed certainty" may also arise in some contractual situations.

Given the reality that certainty is not the norm, such terms as ignorance, uncertainty, and risk are key to the lexicon of decision making. In Figure 2 these key terms are placed in the continuum of knowledge in decision situations.

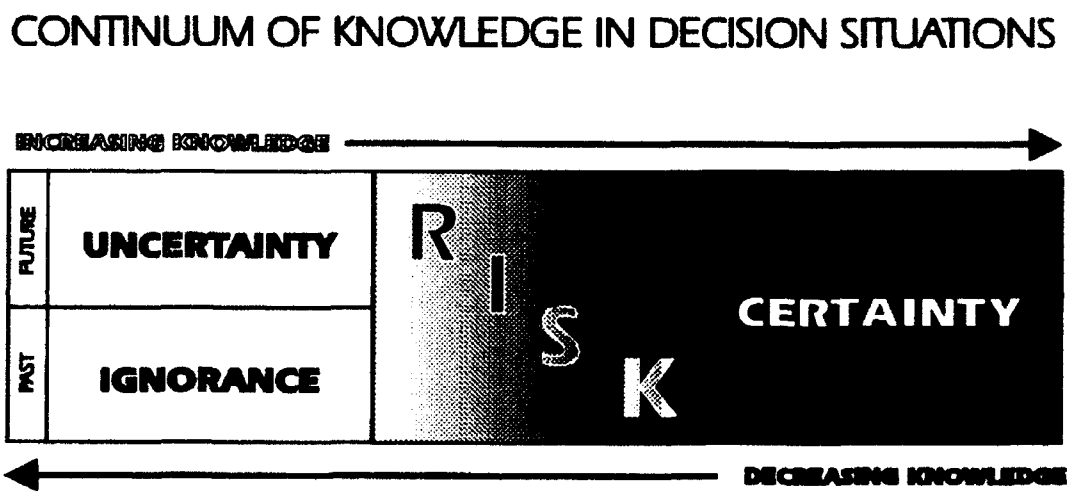

Figure 2.

Uncertainty and ignorance are terms that describe the availability of information about the state or outcome of an event. Ignorance relates to a prior event — one that has already occurred — while uncertainty pertains to a future event. Ignorance can be reduced to zero. If time is available and the cost is affordable, perfect information can be gained on what has happened and "lessons learned" applied to the problem at hand.

Uncertainty implies that more than one outcome is possible for each alternative course of action, but the decision maker does not have enough information to assess the likelihood of each event. Uncertainty may occur when there is a completely new phenomenon, such as the 1973 energy crisis, or the development of a new technology

In the context of decision making, risk can be defined as the possibility that an undesirable outcome will occur, no matter what precautions are taken.[18] In Figure 2 risk is the grey area between certainty and uncertainty. Risk acknowledges that more than one outcome is possible, but the decision maker usually has enough information to determine the probability of each event occurring. Probability is simply a statement of the likelihood that a particular outcome will occur. The relative probabilities of the potential outcomes can be estimated using the subjective judgment of experts or by drawing information from a comparable situation.[19]

Inherent in decision making under conditions of both uncertainty and risk, is the possibility of making a choice that will result in an undesirable or suboptimal outcome. As Figure 2 suggests, decision makers can move from uncertainty toward certainty, and therefore make more informed decisions by increasing their knowledge. That is precisely why the fields of operations research and systems analysis, management information systems, and computer-aided decision support systems are so important to modern decision making.

Interdisciplinary Nature of Decision Making.

Besides being an interrelated, dynamic process composed of integrated individual functions, decision making is also interdisciplinary in nature. Decision making is both a product of, and an influence on, the culture in which it exists. Just as the culture

within which we function is in a continual state of evolution, so too is its effect on the decisions we make. Given the increasing complexity of the worlds' cultures, and associated high rate of technological and social change, it is imperative that decision makers consider relevant aspects of many disciplines. Figure 3 shows some major disciplines that influence the decision-making process.

INTERDISCIPLINARY FRAMEWORK OF DECISION MAKING

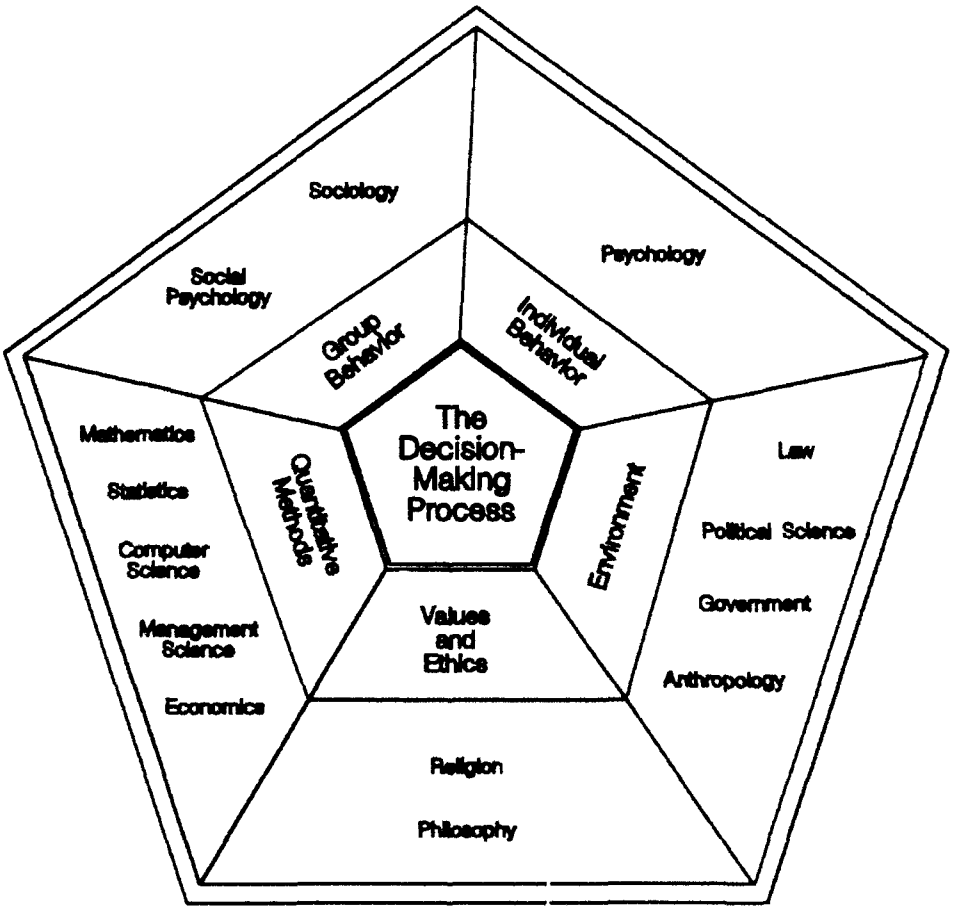

Figure 3.

Effective decision making requires the synthesis of both behavioral and quantitative aspects of the interdisciplinary framework and must consider the influences of the organization's external environment. The defense establishment, like all organizations, operates in an environment containing forces that intrude on the decision-making process. DoD is part of a larger entity, consisting of the political, economic, and social systems of the nation. Laws, political institutions, and the culture and mores of the total society are inescapable and uncontrollable influences of the external environment.

Quantitative aspects of decision making are based on the formal disciplines of mathematics, statistics, and economics. The ongoing explosion of computer technology has fundamentally changed the nature of problem solving, and dramatically increased the utility of quantitative approaches to decision making. Despite that, and the fact that the academic study of decision theory has traditionally emphasized quantitative methods, the executive must remain aware of the effects of behavioral variables on decision making.

Acknowledgment of the behavioral aspects of decision making was driven by the recognition that environmental constraints have a significant influence on decisions, and outcomes should be judged on their qualitative as well as quantitative merits. Individual and organizational values, and the personality and perceptions of the decision maker (or decision-making group) come to bear on each of the decision-making functions These influences find their roots in the disciplines of sociology, psychology, and philosophy, and are strongly affected by religious beliefs.

Decision makers must remain aware of the human constraints on decision making and the inevitable limitations of quantitative methods. A fusion of all aspects of

the various disciplines (Figure 3) into the process model of decision making (Figure 1) will result in decisions more likely to fulfill organizational purposes.

WHAT CAUSES BAD DECISIONS?

Good and bad decisions are characterized not by their outcomes, but by the effectiveness of the decision-making process. Decisions can produce bad outcomes no matter what precautions are taken by the decision maker. This is so because many of the key factors that influence outcomes are often governed by chance events beyond the decision maker's control. Thus, a bad outcome is not necessarily the result of a bad decision. Conversely, bad decisions do not necessarily produce bad results. An overly risky decision (one with a high probability of failure) may be considered bad, but by sheer luck (chance) produce a favorable result.

Bad decisions occur when the decision process is managed poorly or when important process steps are skipped or treated superficially. The most common problems that arise in carrying out the decision process include:[20]

1. *Addressing the wrong problem.* All decision situations have a range of problems and opportunities, some of which are obvious and some are not. A variety of considerations can divert the decision makers' attention from the most important, but less pressing concern. Thus, a premature commitment to action is made without a clear notion of what the real problem at hand is.

2. *Failing to use participation.* Decision makers who fail to encourage participation by stakeholders in the decision often have an incomplete understanding of the problem and what it is about. Participation is also helpful in gaining new perspectives

to solutions and conditions that influence the decision. Moreover, involving stakeholders in the process enhances the prospect of "buy in," leading to greater decision acceptance.

3. Being distracted by conspicuous options. An obvious alternative limits the motivation to search for ideas, which reduces innovation. Further, persons with vested interests may push a conspicuous option. The distraction of a conspicuous means may lead decision makers to ignore important ends.

4. Overreacting to pressure and stress. Complexity, induced by ambiguity and uncertainty, tends to overwhelm decision makers and hinder their understanding of the problem at hand. When stress and complexity combine, decision makers seldom approach decisions systematically. Decisions must frequently be made under the pressure of time. Often, unintended time pressure is created when artificial deadlines are introduced into the decision process. Under the pressure of deadlines, opportunities to understand what a decision is about are seriously eroded. The senior leader must find ways to manage stress-induced conflict if decision making is to improve.

5. Overusing intuition and judgement. Decision makers often prefer to rely on their judgment and intuition rather than on analysis and systematic procedures. Such a preference can lead to a serious distortion of reality and result in decisions that are degraded by an absence of innovative alternatives, weak criteria, limited information, and judgmental bias.

6. Using dogmatic decision practices. Decision makers who are overly reliant on a preferred decision-making technique often become dogmatic. An appreciation of the variety of perspectives that can and should be applied to decision making helps to deepen understanding of the problem and thereby reduces decision-making risks.

7. Failing to deal with values. Values and beliefs can create serious problems for decision makers. Although it is not always obvious, assumptions and criteria are often value-based. Failure to identify and compare values, and to appreciate the role they play in decisions, can easily undermine the decision-making process.

8. Problems in making subjective estimates. Overly optimistic estimates of crucial factors can distort the expected outcome of decisions. The decision maker must gather both quantitative and qualitative information so that each can play an effective role in the decision-making process. Sensitivity analysis can be applied to subjective estimates to see how key factors influence the outcome of given alternatives.

9. Failing to use analysis. Ambiguity, uncertainty, and conflict often make analysis appear to be overly academic and unrealistic. However, properly framed analysis helps to reduce ambiguity and uncertainty, and can provide a way to deal with conflict.

10. Problems in communicating analytical results. Decision makers faced with using analytical procedures are often intimidated by the perception of complexity and fail to appreciate their value. Managers who patiently work through a systematic treatment of analysis will emerge with deepened insights and improved decision-making skills.

11. Ignoring ethics. Difficult decisions are seldom ethically neutral. Subtle ethical concerns arise, for example, during budget drills when financial needs are determined for competing programs and services. The ethical dimension of military decisions will be discussed in more detail in the next section of this paper.

12. Learning. Decision makers seldom learn about missed opportunities and the causes of failures and, therefore, proceed down the same blind alleys again and

again. The realities of life make it difficult to openly discuss failures. Bad outcomes are carefully revealed to superiors, and even then bad news is often offset with good news to cushion the blow. To break this trend, the blamefinding mentality of post-decision reviews must be broken by offering incentives that allow open discussion of decisions.

In summary, bad decisions occur when foreseeable events are not recognized and managed effectively. Informed decision makers adopt good decision practices and take realistic steps to appraise outcomes, seeking ways to improve their decision-making capacity.[21]

MILITARY DECISION MAKING

The decisions a general has to make would furnish a problem of mathematical calculations not unworthy of the powers of a Newton or an Euler.

—Clausewitz. On War, 1832 [22]

The purpose of the DoD is to maintain and employ armed forces to preserve the security of the United States and to advance and uphold its interests worldwide. The critical nature of this mission, and the large share of the nation's wealth and resources allotted to it are compelling reasons for our military leadership to manage wisely and well.

The decision-making processes and techniques used by senior military leaders differ little from those used by their civilian counterparts in the corporate community. That is not to say, however, there is no difference between military and corporate decision making. It is only necessary to recall the ultimate purpose for which each entity was established to understand the distinction between corporate and military decisions.

The major distinguishing factors between corporate and military decisions are the extent of second-and third-order effects and the consequence of failure. Faulty decisions in the world of commerce may have dire effects on the enterprise itself and its workforce, and a rippling effect on related firms and the community. Flawed defense decisions, on the other hand, can threaten the very security of our nation and its way of life. Further, even relatively insignificant DoD decisions can affect sizable portions of our society, either directly or indirectly. For example, closing an Army base, delaying a procurement program, or executing a reduction in force can have nontrivial and widespread economic, social, or political repercussions.[23]

Defense Planning Systems and Processes.

Defense decisions begin with the difficult and classical force planning problem of deciding just how much defense is enough. The problem becomes even more complex once constraints are imposed, e.g., limited dollars and force levels, manpower, "fences" on specific programs, etc. The problem of choosing how to employ these scarce resources most effectively and efficiently is one of the most challenging tasks confronting defense decision makers.

At the top levels of defense management, decision making can be divided into "strategy" decisions and "resource" decisions. Strategy decisions generally pertain to the concept for the use of military forces (roles and missions), the sizing and readiness of forces, the deployment of forces, and their operational command and control. These decisions are largely executive and involve the President, his National Security Adviser, the National Security Council, the Secretary of Defense (SECDEF), the Joint Chiefs of Staff, and the unified and specified commanders in chief (CINCs). Resource decisions,

on the other hand, pertain to the more detailed determination of *requirements* for resources (manpower, materiel, facilities, and operating funds) and the *allocation* of these resources to permit the forces to carry out their roles and missions. The common denominator in these decisions is dollars. As such, the Congress plays a necessary and influential role along with the President, the Office of Management and Budget, SECDEF, and the Services, who administer and provide the resources to carry out strategy decisions.

There are three major planning and resourcing systems within the DoD that comprise the decision-making framework within which policy guidance from the National Command Authority is translated into military capability, and plans for using that capability. These systems are the Planning, Programming, and Budgeting System (PPBS), the Joint Strategic Planning System (JSPS)and the Joint Operation Planning and Execution System (JOPES). The PPBS decides military requirements and programs resources. The JSPS provides the means for the Chairman of the Joint Chiefs of Staff, in consultation with the Service Chiefs and CINCs, to assess the security environment, evaluate the threat, and propose the military strategy and force capabilities necessary to achieve the U.S. national security objectives. The PPBS and JSPS are force planning systems; JOPES, on the other hand, is an operations-planning system. The JOPES provides the procedural foundation for an integrated and coordinated approach to developing, approving, and publishing plans for employment and deployment of military forces.

The Ethical Dimension of Military Decision Making.

An important part of the heritage of the United States is the unique relationship that exists between the American people and their armed forces.[24] This relationship rests on the solid foundation of ethical principles and values that guide every American soldier. Indeed, the oath each soldier takes upon entry into military service is a formal and public recognition of his or her commitment to an ethic that distinguishes soldiers in American society. The Army ethic is a reflection of the larger moral, spiritual, and social values upon which our nation was founded.

The one factor that distinguishes military leadership at the senior levels of command is the ethical visibility of senior leaders and their fundamental charge to represent selflessly the organization, the profession, and the nation in all that they are and do.[25]

FM 22-100 defines ethics as the "principles or standards that guide professionals to do the moral or right thing — what ought to be done."[26] Stated another way, ethics denotes the application of values to the decision-making process. According to Harrison, values provide a kind of guidance system used by an individual when confronted with a choice among alternatives.[27] Ethics are the standards of decision making, and every part of the decision-making process is affected by the ethical interest.[28]

Not all decision situations are absolutely clear-cut. Real life requires many compromises and decision makers sometimes experience a twinge of conscience. An ethical dilemma exists when two or more deeply held values collide. In such situations, the decision maker should review the decision-making process using the idea of highest morale good. He should think through the entire decision-making process, from objective

setting through implementation and follow-up, carefully considering all the factors and forces that relate to the dilemma. Eliminate any option that will not serve the nation well. In this manner, the decision-making process will help to identify the course of action with the greatest moral good.

If the decision maker has the slightest doubt as to the right decision, he should apply the "Washington Post test." That is, would he be embarrassed if his actions or decisions were to appear on the front page of tomorrow's newspaper — and without benefit of sympathetic explanation?

Almost every major decision has ethical implications. Military decisions, since they involve human lives and the core values of our society, have a more insistent ethical dimension. Senior decision makers must always identify and examine that dimension when evaluating alternatives and when considering the second- and third-order effects of their decisions.

Second- and Third-Order Effects.

The first-order effect of a decision is its direct outcome. If the implemented decision is successful, the first-order effect is the desired outcome and will hopefully serve the organization's purpose. Second- and third-order effects are the non-primary, consequential outcomes of decisions . . . the way decisions play out at much lower levels. They may be intended, unintended, beneficial, or harmful to an organization Anticipating the second- and third-order effects of decisions is an often difficult, but always necessary, *responsibility of senior and strategic leaders.*

Evaluating and comparing alternative courses of action must include consideration of second- and third-order outcomes. An organization's character is framed

by the second-order effects of decisions. Proactive leaders will shape the future organization by selecting the second-order effects that will produce the desired future results.

Except in rare instances, senior leaders should give more weight to significant second- and third-order effects than to first-order effects. This is particularly true in areas dealing with institutional values. They are longer-term in nature, and harder to reverse once established. They may also have greater long-term impact on an organization's performance and character.[29]

Limits and Focus of Military Decision Making.

Current U.S. Army leadership doctrine recognizes three levels of leadership — *direct, senior, and strategic* — and three categories of leadership competencies — *technical, interpersonal,* and *conceptual.* As officers rise from the direct to strategic level of leadership, the relative importance of technical competence decreases as conceptual competence increases and interpersonal competence remains generally constant. Similarly, each leadership level has a different scope and level of discretion for required decision-making and problem-solving activities. Decision authority is bound by discretionary limits, which are normally narrow at the lowest organizational echelons, and broader at higher echelons (Figure 4).

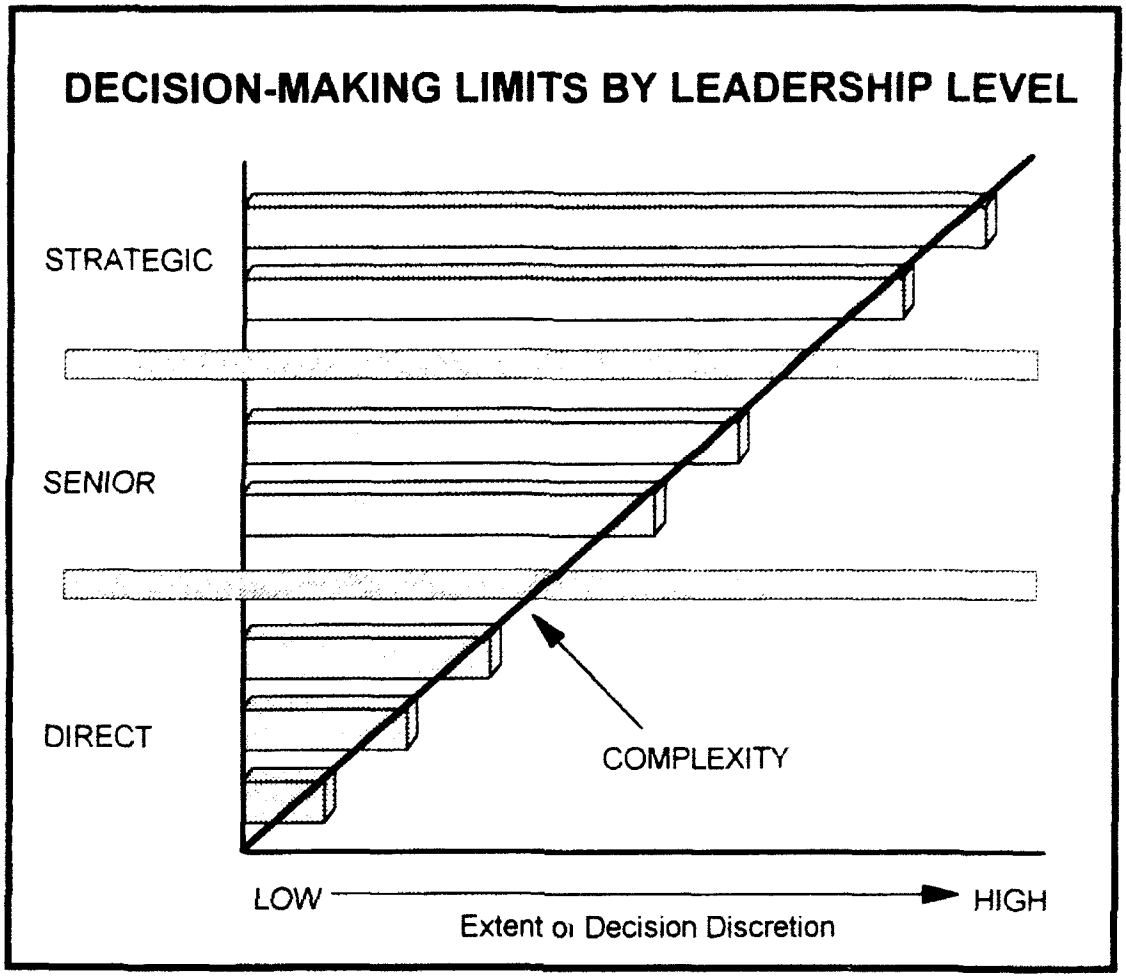

Figure 4.

(Adapted from DA Pamphlet 600-80)

Discretionary limits of decision making vary in response to several factors:[30]

- Complexity of the decision problem. By their very nature, hierarchical organizations provide maximum clarity at the lower echelons about what is to be done and the methods that are to be used. Discretionary limits must be broader at higher echelons where problems are unique and solution alternatives cannot be prescribed in advance.

- Frame of reference. Discretionary limits broaden as leaders develop a more encompassing frame of reference to solve problems and make decisions.

- Amount of resources available for discretionary purposes.

As complexity, discretionary limits, problem structure, and the nature of critical tasks change, each organizational "layer" requires different information, planning, and control subsystems to meet its needs. Table 1 portrays the changing nature of decision objectives by level of leadership.[31]

DECISION OBJECTIVES BY LEVEL OF LEADERSHIP

Level	Decision Purpose: Examples
Strategic	• Design new organizations to achieve future required operational capability • Ensure that needed resources will be available • Monitor the character of the total organization
Senior	• Maintain operating effectiveness at the direct level through planning, programming, and prioritizing • Create optimum interdependence of subordinate elements
Direct	• Accomplish the tasks and missions of the organization • Assimilate new members; take care of all members

Table 1.
(Adapted from DA Pamphlet 600-80)

OPERATIONS RESEARCH AND SYSTEMS ANALYSIS

It is better to be satisfied with probabilities than to demand impossibilities and starve.

—F C S Schiller [25]

The Evolution of Quantitative Analysis.

Before the twentieth century, enterprises operated in a relatively simple, stable, and predictable environment. Consequently, managers could make effective decisions using the process of deductive reasoning we call intuition, or by imitating the methods used successfully by other managers. These measures rarely tackled the problem systematically and did little to advance the managerial decision-making process.

Around the turn of the century early pioneers in manufacturing processes gave birth to the "scientific school" of management thought. American engineers Frederick Taylor and Henry L. Gantt developed processes to analyze and improve worker performance and production scheduling. Although limited to improving the efficiency of specific tasks at the lower levels of organizations, these early approaches to production and operations management signaled an end to the intuitive approach to decision making.

During the early twentieth century other contributors applied mathematical techniques to solving a variety of problems. It was during this period that the concepts of probability and statistical inference, queuing theory, and mathematical forecasting evolved. Despite these advances, it was not until World War II that quantitative approaches to decision making were extensively used.

Operations Research.

World War II presented management problems of unprecedented extent to military decision makers. To maximize the war effort, it was necessary to allocate scarce resources effectively to the various military theaters and to individual operations within each theater. Problems in production planning and scheduling, inventory and quality control, transportation and logistics, and other areas threatened to overwhelm the war effort. At the time, there was no one experienced in dealing with these enormously complex problems. The problems were, obviously, far too important to revert to the intuitive way of management. Strategic leaders recognized the need for an innovative approach to management based on analytical reasoning. First the British, and then the Americans, commissioned multidisciplinary teams of individuals with diverse backgrounds and skills to study the many strategic and tactical problems, and to derive a scientific approach to solving them. The teams consisted of organizational specialists, physicists, engineers, mathematicians, statisticians, economists, and military planners. These were the first "operations research" teams; to them, much of the credit for the success of the war effort is due.

After the war many ideas used by the military operations researchers were systematically applied to solving related industrial problems. The ever-increasing complexity of enterprise, driven by the burgeoning American economy, prompted business organizations to employ the tools of operations research. As the discipline of operations research matured, practitioners devised new names to capture the subtle nuances of each particular domain of activity in the field. Such terms as "operations analysis," "decision analysis," "decision science," "cost-benefit analysis," "management science," and others have emerged. Rather than belabor the differences between the

various domains, it is sufficient here to provide a simple definition that encompasses all of them: operations research is the scientific method applied to problem solving and decision making.

Systems Analysis.

Operations research techniques were mainly quantitative in nature, and concentrated on the mathematical aspects of problem-solving. It was not until the 1960s that the broader-visioned "systems analysis" approach to decision making evolved, and again, it was a product of the defense establishment.

Defense Secretary Robert S. McNamara introduced systems analysis to the DoD in 1961, when he brought a group of visionary analysts to the Pentagon to help solve widespread problems with weapons system development and acquisition. Because of its success in helping to shed light on many complex defense problems, President Lyndon B. Johnson directed that systems analysis become a model for the civilian governmental agencies. Systems analysis is still used throughout the federal government, and is an integral part of the Planning, Programming, and Budgeting System (PPBS). It is also widely used at state and local levels of government, and in the business and private sectors.[33]

Systems analysis is formally defined by the Army as "an orderly study of a management system or an operating system using the techniques of management analysis, operations research, industrial engineering, or other methods to evaluate the effectiveness with which missions are accomplished and to recommend improvements."[34]

Like its predecessor, operations research, systems analysis embraces the quantitative approaches to problem solving, but it goes beyond that by adding the human

dimensions of creativity and judgment. Unlike operations research, which primarily applies only to the appraisal phase of the decision-making process, systems analysis relates to the whole problem. It typically involves a systematic investigation of the decision maker's objectives and the relevant criteria; a comparison—quantitative when possible—of the costs, effectiveness, time and risks of each alternative course of action; and an attempt to formulate additional alternatives if those examined are found deficient. Cornell says "the real goal of systems analysis is to teach decision makers to think in a special, orderly, and thorough way." [35] If it achieves that goal, systems analysis yields a vital product—quality decisions.

QUANTITATIVE ASPECTS OF DECISION MAKING

The mathematicians are a sort of Frenchman: when you talk to them, they immediately translate it into their own language, and right away it is something utterly different.

—Goethe [36]

To a large extent, problems confronting defense decision makers are quantitative in nature. Throughout the Army planning system commanders and managers are faced with program and budget decisions; problems in resource allocation, weapons system analysis, force requirements; and the like. There are many quantitative techniques available to help decision makers arrive at a choice with the highest probability of meeting the organization's objective.

The greatest contribution of quantitative techniques is in the appraisal step of decision making. Once alternative courses of action have been defined, these techniques can be powerful tools for making quick and accurate evaluations, and comparing

alternatives. Quantitative methods, if selected well and used wisely by the decision maker, can reduce uncertainty and so yield choices that are more likely to result in reaching the original objective.

Skills required in the *qualitative* aspects of decision making are usually innate in the manager and improve with experience. Skills in the *quantitative* approach, on the other hand, can be learned only by studying the assumptions and methods of operations research or management science. A manager can increase his or her decision making effectiveness by learning more about quantitative methodology and by better understanding its contribution to the decision-making process. The manager who is knowledgeable in quantitative techniques is in a much better position to compare and evaluate the qualitative and quantitative sources of recommendations and ultimately to combine the two sources to make the best possible decision.

Models and Modeling.

Models are attempts to put the complexities and uncertainties of a decision-making problem into a logical structure amenable to formal analysis. The function of a model is to provide a *simplified* representation of a system, to serve as a tool for analysis of the system's behavior, and provide insights into its operation. Models may be iconic, analog, or symbolic. Examples of the model types, in order of increasing abstraction, are:

- Iconic model: A physical replica, such as a scale model railroad, a link flight simulator for training aircraft pilots, or a sand table topographic map.

- Analog models: Deal with more abstract ideas, such as speed, temperature, time, space, and processes. Analog models are physical in form, but do not look like the real thing; for example, a mercury thermometer is an analog model representing temperature; a watch is an analog model representing time. An electronic network model can be constructed to represent a transportation system.

- Symbolic models (also called mathematical models): Some situations are so complex they cannot be represented physically; or a physical representation would be too cumbersome, time-consuming, or expensive to construct. In such cases, symbolic models are used to represent the real situation with a system of symbols and mathematical expressions. For example, the time-phased flow of forces through a port of embarkation could be modeled, using symbols and equations to relate interarrival time, maximum queue size, time spent in the queue, and so on.

Symbolic models are an essential part of any quantitative approach to decision making, particularly within complex systems. Such models require the developer to state explicitly his assumptions about the important elements and the cause-and-effect relationships of the real situation. As such, symbolic models force the modeler to develop a true understanding of the object system. As with all simulations, the validity of the assumptions and relationships is paramount to the reliability of the model.

In operations research, models are usually symbolic. The mathematical symbols and functions of the model represent decision variables and relationships to describe the behavior of the system. The solution of the model is obtained by applying advanced mathematical solution techniques, such as linear programming. Using mathematics as the language for model representation allows us to take advantage of high-speed

computers to model complex systems.

The goal of the model builder is to construct the simplest model that predicts the outcomes well and is consistent. A model that is precisely faithful to the real-world system would be too complex, difficult and expensive to construct, and might ultimately be beyond human comprehension. The modeler should highlight those factors most relevant to the problem at hand, and eliminate or suppress those that are not essential.

A well designed model, used wisely, can be of invaluable assistance to the decision maker. Unlike most quantitative methods that apply mainly to evaluating alternatives, models have application throughout the decision-making process. Models can help to establish and validate objectives, and to develop, test, and validate alternatives. In evaluating and comparing alternatives, a model can be used to weight and rank the various courses of action. Once the information provided by the model has helped the decision maker to arrive at a choice, the model's capacity for providing feedback can also help to monitor the results of the decision. By monitoring the feedback from the model, the decision maker will be aware of the need for corrective action.

There are both advantages and disadvantages to using models for decision making. The advantages of models are:

- They allow analysis of a system without interfering with its ongoing operations.
- They allow analysis to be accomplished faster, with less expense, and less risk, than if the analysis were made while working the real system.
- They can be modified quickly and effectively.
- They can be readily understood by the decision maker.

The major disadvantage of models, especially in complex systems, is the difficulty of capturing the reality of the real-world system This is especially true if there are constraints (budgeting or time) on model formulation and/or data collection. Many assumptions and simplifications are embodied in most models, often without being made explicit. The validity of the conclusions and decisions drawn from a model will depend on extent to which its assumptions deviate from the real world situation.

The Army uses modeling for a wide range of applications, from concise mathematical models used to examine a specific weapon, to extensive command post exercises involving hundreds, or even thousands, of participants. Their purposes include training and education; operations planning and evaluation; analysis of force structure; R&D planning, management, and evaluation; and others. Specific models have been developed for logistics, electronic warfare, and many other facets of the modern battlefield. A notable subset of modeling employed extensively by the military is wargaming, which will be discussed in more detail later in this paper.

Quantitative Concepts and Techniques.

The purpose of this section is to provide a sampling of the quantitative concepts and techniques available to aid decision makers in making choices and a brief description of each. It is not a complete listing of the many methods available in the fields of economics, mathematics, statistics, management science, and other sources; nor is it a full explanation of the select concepts described. The reader interested in further study of these and other techniques should consult one of the many texts available on the subject, several of which are included in the list of references at the end of this paper.

Cost-effective Analysis is an analytical approach to solving problems of choice. It requires a definition of objectives, an identification of alternatives, and an established measure of effectiveness. Its goal is identification of the alternative that yields the greatest effectiveness for a given cost — or the alternative that produces the required level of benefits at the lowest cost.

Decision Trees. A method of graphically displaying the sequence of decision alternatives and events involved in making a decision under uncertainty. The decision tree is analyzed by calculating the risk and expected value for each event node (based on probability) and choosing the sequence of actions with the optimal outcome.

Economic Analysis is a systematic evaluation of alternative solutions to a specific mission requirement in terms of comparative costs and benefits. Economic analyses help decision makers allocate scarce resources. The economic analysis highlights the assumptions from which decisions are made and it highlights the sensitivity of key variables affecting the decision. The concepts of economic analysis and program evaluation are an integral part of the Army PPBES. Department of Defense Instruction 7041.3 (Economic Analysis and Program Evaluation for Resource Management), and Army Regulation 11-18 (The Cost and Economic Analysis Program), provide policy guidance for implementation of this program.

Expected Value is the probability of an event occurring multiplied by the payoff associated with its occurrence. If expected value is the sole criteria, the decision maker would choose the alternative providing the highest positive value.

Game Theory is a branch of analysis concerned with models of conflict between two or more opponents under specified rules. It is used to determine the optimum strategy in a competitive situation. The decision maker can anticipate an active,

rather than passive, reaction from the environment. Outcomes will be decided by the collective actions of all competitors, rather than by the choice of a single competitor. To make an effective decision in conflict situations, the decision maker must consider the opponents' alternatives, anticipate the opponents' actions, and then develop an appropriate strategy. Decision strategy is formulated with the presumed goal of maximizing gain and/or minimizing loss.

Gaming is a simulation method where human participants are actively involved and play specific decision-making roles. This technique is useful for examining policies and strategies under the conditions of a particular scenario, allowing factors (human or chance) to vary.

Inventory Models are used to help managers faced with the dual problems of maintaining sufficient inventories to meet demand for goods, while incurring the lowest possible inventory costs. Inventory costs include procurement costs, carrying costs, and shortage (stockout) costs. Quantitative inventory analysis can significantly improve the effectiveness of an organization.

Linear Programming is probably the best known and most applied quantitative technique available to analysts and decision makers. It is a mathematical method of planning the optimum allocation of limited resources in situations where there is a wide range of possible alternatives. A linear programming model is limited to those circumstances where the relationships between the variables are linear (not exponential), and there is a single performance measure or objective. It is an efficient way of solving problems when a choice must be made from alternatives too numerous to evaluate intuitively or by other conventional methods. The linear programming computational

algorithm is easily adapted to a computer, and is therefore a valuable tool in solving complex problems.

Markov Process Models are useful in studying the evolution of certain systems over repeated trials. Markov processes can be analyzed to predict both short-term and long-term future behavior, once the process is specified. For example, Markov analysis can be used to determine the probability that a machine or weapons system that is functioning in one period will continue to function, or break down, in another period.

Network Models enable managers to cope with the complexities and interdependencies involved in large projects. A network is a graphical representation of a problem consisting of nodes that are interconnected by lines called arcs. Specialized solution procedures allow analysts to quickly solve many managerial problems in such areas as transportation system design, information system design, and project management. Transportation, assignment, and transshipment problems are variations of network models.

PERT/CPM. In many situations managers are responsible for planning, scheduling, and controlling projects that consist of many separate activities performed by a variety of individuals, departments, or organizations. This task is further complicated by the interdependence of some activities; that is, some activities depend on the completion of other activities before they can be started. PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method) are network-based procedures for helping managers carry out complex project management responsibilities. The critical path is the longest path in the PERT/CPM network; it represents the total time required to complete the project.

Probability is a statement of the likelihood of an event happening. In mathematical terms, it is the ratio of the chances favoring a certain happening to all the chances for and against it. In probability, a percentage of chance between zero and 100 percent is assigned to each possible outcome. The sum of all possible outcomes of an event must equal 100 percent. If, in the case of a particular anti-armor missile, the probability of kill (P_k) if the missile hits a tank is 90 percent, it follows that the probability of not killing the tank (P_{nk}) is 10 percent. Using the concept of probability, analysts can build risk assessment into many quantitative methods used to generate information to aid in the decision-making process.

Queuing Models, also known as Waiting Line Models, were developed to help managers understand, and make better decisions about, the operation of processes that depend upon passing through required stages. These techniques analyze the feasibility of adding facilities or increasing throughput, and assessing the amount and cost of waiting time. Analytic techniques can be employed to solve queuing theory problems, but, due to the complexity of real-world systems, simulation is usually used.

Regression Analysis is a mathematical method used to establish the causal relationship, if any, between observed and quantifiable variables. It is a very useful technique of determining an unknown, related variable by plotting a curve using a simple mathematical equation applied to results from past situations. By using data derived from different situations at different times, we can predict what will probably occur in another situation in the future.

Simulation. Many problems are too complex to solve using analytic mathematical techniques, and in some problems there is not a measurable criterion to

suggest a best choice. In these situations, the only feasible method of analysis may be simulation — using a model to describe a real-world system, and then studying the system's characteristics and behavior by experimenting with the model's variables. Simulation is not an optimization technique — that is, it is not used to find a best solution It is a means to perform "what if" analyses. Since most simulations deal with large and complex problems, a computer must be used to perform the required operations and calculations in a reasonable time frame. By using specialized computer systems, uncertain situations with a wide range of alternatives, under a variety of conditions, can be sampled many times to generate a distribution of potential consequences. To ensure that the simulation model "behaves like" the real-world system, great care must be taken to ensure that the simulation model truly reflects the real system.

Transportation Models are a special class of linear programming algorithms with the objective of finding the most effective way to distribute a commodity from a group of supply sources to a set of demand destinations.

Tools are Just Tools.

A word of caution about quantitative analysis is warranted. Though these techniques are powerful tools to aid the decision maker, we must be careful not to become too impressed with them. They are still just tools. Like the craftsman, the decision maker must find the right tool for the job; he should use the tool only for those jobs for which it is intended, and he must be skilled in using it properly. Finally, he should never become so enamored with the tool that he views it as an answer machine and allows the tool to make decisions.

Gary Klein, the noted decision research scientist, relates the story:

> To the boy with the hammer, the world is a nail. Tools can be useful, or dangerous. A hammer is useful for pounding nails. If we see an ant on a linoleum floor, a hammer can also be useful. If we see an irritating fly come to rest on a window pane, a hammer may be . . . overkill. [37]

Information from quantitative methods should be limited to those aspects and elements that have consequences pertinent to the decision at hand. It should be complete enough to focus the decision maker's thinking, but not so much that he is overwhelmed with information and fails to concentrate on the key issues.

We should also be cautious not to become mesmerized by the logic of numbers. Decision making is more than just number crunching and data. The careful decision maker will understand that analysis cannot do the whole job. He will constantly challenge the assumptions that underlie the numbers. He will not mechanically believe everything analysts tell him, but will employ his judgment and experience to judge when quantitative analyses are needed, how to use them, and when to trust them.

Quantitative analysis focuses on the physical aspects of reality, and applies mathematical processes to a decision model that can be "solved." Although the mathematics may be *objective* the choices of models and parameters, the underlying assumptions, and often the methods of solution are all *subjective*. While the ability to apply the objective aspects of decision making is often necessary, it is rarely sufficient. The decision maker must also have the skills to deal with the subjective aspects, and the experience and vision to blend the quantitative and qualitative disciplines and apply them toward achieving his ultimate goal—quality decisions.

QUALITATIVE FACTORS

While quantitative techniques are excellent tools in the appraisal phase of decision making, they are unable to set objectives or suggest alternatives. Although they can be used to compare and recommend solutions, they cannot provide the judgment to make a choice. Though quantitative methods can provide mechanisms to monitor the results of a decision, they do not provide a means to judge the adequacy of the outcome. These capabilities are within the subjective realm of personality, creativity, critical thinking, and experience.

Nearly all defense decisions involve some aspects that are qualitative rather than quantitative in nature. Often as not, the qualitative variables come into play not as factors in the primary outcome of the decision, but as elements of its second- and third-order effects. For example, major decisions may affect leadership and morale in the organization, or civil rights, the environment, or other areas of social responsibility. Many of these factors cannot be expressed in quantitative terms. How then does the decision maker deal with these variables?

Two extreme attitudes must be avoided. One such extreme attitude would ignore qualitative factors on the grounds that factors that cannot be measured are not important. The opposite extreme would argue that quantitative models have no value given the overriding importance of qualitative factors. [38]

The sensible approach is to accept the idea that quantitative techniques can deal effectively with the measurable aspects of the decision problem, but rarely are they sufficient in and of themselves. Quantitative methods must be tempered by the judgment supplied by knowledgeable leaders. It is here the decision maker's personality, critical thinking, and experience come into play. The senior leader who finds an appropriate

balance between the quantitative and qualitative factors will reduce uncertainty, and make choices that are more likely to achieve the original objective.

COMPUTER TECHNOLOGY

Most operations research studies require the use of a computer. This may be due to the complexity of the mathematical model, the volume of data to be manipulated, or the substantial computational effort required. Without computer assistance the operations research analyst may require days, or even weeks, to complete the required mathematical calculations manually. Moreover, the manual process would be tedious, prone to error, and costly. For that reason, computers have been closely associated with the evolution of operations research since its inception during World War II.

More than any other development, the virtual explosion in computer technology has enhanced the use of the quantitative approaches to decision making. Since their introduction to widespread use in business and the government in the 1950s, computers have declined in cost and size and increased in processing power. Microcomputers are now more powerful than the mainframe computers of the 1960s. Solutions to problems so complex they were thought unsolvable just a decade ago are now being found on notebook computers that will fit in a briefcase.

Today, inexpensive but powerful microcomputers and accompanying user-friendly software allow even small organizations to employ operations research techniques to support decision making Specialized project management and decision support software is proliferating throughout the business world and government. Many quantitative methods can easily be set up on a spreadsheet program developed for

personal computers. These spreadsheets are widely available, are easy to use, and are ideal for analysis of basic quantitative problems.

Decision Support Systems.

Decision support systems (DSS) are integrated computer systems designed to aid management decision making. A DSS incorporates one or more analytical methodologies, and the computer system performs the calculations necessary to solve the model. A DSS is, however, often more than just a model. It usually encompasses a database that can be used to provide information directly to the decision maker. A DSS sometimes provides decision graphics or other reports that are readily understandable by the user. Current computer technology enables a DSS to be "user friendly," making it quick and easy to solve quantitative problems or to query the database for needed information.

A DSS *does not* render decisions; nor does it predefine problems, impose solutions, or automate the decision-making process. The DSS *does* provide highly specialized tools that support (not replace) the decision-making process of setting objectives, developing and evaluating alternatives, making and implementing choices, and monitoring results. A DSS can expand the manager's competence in dealing with problems and significantly improve outcomes from the decision-making process.

Employing a DSS also fosters collaboration between the decision maker, operations research analysts, and information specialists. Directly involving management in quantitative analysis will improve communication and cooperation within the organization, and help to break down the barriers to successful implementation of the decision-making process.

There are, however, dangers to employing computers and decision support systems. The danger comes when we stop thinking and start believing everything the computer tells us. In the old days, before computers were available to crunch the numbers, researchers had to manipulate all the data by hand. The researchers could readily see subtle trends, variations, and surprises, and catch errors that didn't make sense. Now, computer programs make data analysis so fast and easy, analysts sometimes lose the feel of the data, the sense of what is being analyzed, and sometimes even an appreciation for what the original problem was. [39]

We must never lose sight of the fact that a DSS is but a tool for the decision maker. Its value is that it can speed the process of computation and analysis, and handle mathematical problems so complex that manual solution would be infeasible. It can help us to manipulate and integrate volumes of data that would otherwise be unmanageable. But the DSS cannot provide the experience and judgment of the human decision maker, and we should never expect it to.

Army Decision Support Systems.

An example of a DSS currently employed by the Army is the Military Occupational Specialty System (MOSLS). The MOSLS employs a variety of operations research methodologies to project the Army's enlisted strength, broken down by pay grade and skill, over a seven-years period. MOSLS also generates the promotion, reenlistment, reclassification, and skill training recommendations needed to meet the Army's projected personnel requirements. Since its implementation in 1984, the MOSLS has enabled the Army to reduce noncommissioned officer force imbalances from 48

percent to 30 percent, and to save about $65 million per year from NCO position alignments alone.[40]

The Army is developing a new Army Decision Support System (ADSS) to provide decision makers current and accurate information on which to base decisions within the Army planning process. The present computer support system for programming, budgeting, and operating decisions is functionally oriented and geographically dispersed throughout the world. Since the system does not have a common database, information used by decision makers is often uncoordinated. For example, a training command may be scheduled to begin training on a new weapons system while the delivery date for that system has been delayed due to production problems experienced by the vendor. The new ADSS incorporates a common database and will alleviate problems of this sort.

WARGAMING

Deciding how to best employ limited resources to accomplish the Army's goals and objectives is among the most challenging tasks confronting our senior decision makers. An even more demanding and crucial test of our senior leaders and their staffs is the successful resolution of national and international crises.

Crisis management requires skills and experience of a type and level few elected or appointed civilian executives have before assuming their new duties and responsibilities. Senior military officers have generally had some exposure to crisis management seminars at one of the Senior Service Colleges (SSCs), and have acquired related experience, although usually at a lower level, in one or more command or staff assignments.[41]

In times of crisis, military leaders and civilian Defense and State Department officials must work in concert among themselves and with many other government agencies. Seldom, except for actual crisis situations, do these agencies and individuals interact under circumstances and conditions that can provide the relevant experience and skills necessary to effectively manage crisis.

On-the-job-training during actual crises can be enormously costly in terms of manpower and national resources, and it can lead to short-sighted solutions with disastrous long-term consequences.[42] Fortunately, there are means available to provide valuable training and experience to potential crisis managers. The most notable of these techniques is the practice known as wargaming.

Far from being a revolutionary new concept, wargaming has been used as a tool for studying defense issues for many years. The ancient Chinese warlord Sun Tzu used wargaming techniques to plan his campaigns more than twenty-five centuries ago. In recent years, computer-assisted wargaming has enjoyed a tremendous jump in popularity among both home hobbyists and military professionals.[43]

Wargames are warfare models or simulations that do not involve actual military forces. The flow of events of the game is affected by, and in turn affects, decisions made during the course of events by "players" representing the opposing sides. A wargame is an exercise in human interaction, and the game revolves around human decisions. Learning from wargames comes from the experience of making decisions, understanding how and why those decisions are made, and recognizing their effects.

Although wargames often employ mathematical models similar to those of quantitative analysis, these models are employed in fundamentally different ways. Wargaming models are stochastic in nature—that is, a "roll of the dice" provides the

range of possible outcomes that serve as the "reality" with which the decision makers must deal. Thus, while model results are considered the "outputs" of quantitative analysis, they are "inputs" to wargames. While quantifiable behavior is the paradigm of quantitative analysis, human behavior and the decisions people make are the paradigms of wargames.[45]

Since wargames are imperfect mirrors of reality, they are best suited to investigating processes, not determining outcomes. They are valuable as tools to study the "issues raised" in the decision-making process, rather than the "lessons learned" from it. Once the "issues raised" are illuminated by the wargame, other techniques can be used to help predict the outcomes of those issues.

Wargaming can be most productively used as a training aid, or as an exploratory or explanatory device. When used as a training aid, wargames provide players a means of practicing decision making under a variety of situations. They thereby get experience they could not gain in any other way, short of actual conflict or crisis. As an exploratory tool, wargames can give participants new insights into the effects of unquantifiable factors in the decision-making process. In this way, they can also serve as a useful mechanism to gain an understanding of the dynamics of real world situations and to explore questions of strategy and warfighting trends. Finally, as an explanatory tool, wargames can be a very effective way of communicating new ideas to other members of the community in vivid and memorable ways. [46]

Owing to the increased attention wargaming is receiving throughout the DoD, a number of activities are emerging to foster wargaming at the strategic and operational levels. The Army is currently constructing a state-of-the-art wargaming facility at the U S.

Army War College (USAWC) at Carlisle Barracks, which will house the Army's Center for Strategic Leadership (CSL).

The mission of the CSL is to conduct strategic and joint/combined operational wargame and exercise activities in support of the USAWC and the U.S. Army. The CSL develops and executes manual and computer-assisted wargames and exercises to help students explore alternatives, gain insights, and practice decision making under a variety of situations. CSL also participates with other SSCs and the DoD community in the development of joint wargaming models, exercises, and analytical tools. Examples of these joint efforts include the Global Wargame sponsored by the Naval War College and the Joint Land, Aerospace, and Sea Simulation (JLASS), which involves all SSCs.

The CSL's new multipurpose facility is scheduled for completion in 1993 and full operation in 1994. In its new home, the CSL will be the heart of the Army's study of landpower and its applications into the twenty-first century.

SUMMARY

Decision making is a difficult skill to master. At the same time, it the most important activity senior leaders perform.[47] The events of the past few years serve to emphasize the difficulties confronting defense decision makers. The unprecedented pace of change in the global environment makes it difficult to interpret our national security needs and adjust to them. Especially daunting is the prospect of downsizing the military while we are facing a whole new, and uncertain, set of challenges across the globe. Now, perhaps more than any time in our history, it is imperative that our senior military leaders are competent decision makers.

All military officers, whether in command or staff positions, are called upon to make decisions or to participate in the decision-making process. Senior leaders provide the strategic vision and set the objectives for the Army. Staffs and subordinates can propose alternatives and analyze information, and compare and recommend courses of action. However, their effort does not relieve senior leaders of the responsibility to analyze information themselves as part of the decision-making process. In the end, the senior leader alone must make the final decision and accept personal responsibility for a successful outcome.

> *Executives are responsible for the future. In essence, today's Army reflects yesterday's decisions. The decisions that will determine the capabilities of the Army of the 21st Century are being made today.*
>
> *—DA Pamphlet 600-80, Executive Leadership*[46]

ENDNOTES

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[7] Department of the Army, Executive Leadership Department of the Army Pamphlet 600-80 (Washington: U.S. Department of the Army, 19 June 1987), 33.

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[9] Charles H. Kepner and Benjamin B. Tregoe, The New Rational Manager (Princeton: Kepner-Tregoe, Inc., 1981), 103.

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[27] Harrison, 63.

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[29] DA Pamphlet 600-80, 40.

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[31] Ibid, 34-35.

[32] Baird, 134.

[33] Alexander H. Cornell, The Decision-Maker's Handbook, (Englewood Cliffs, NJ: Prentice-Hall, Inc., 1980), 16.

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[43] Kapper, "Wargaming II: Sun Tzu, The Spring Offensive and the Home Hobbyist," Defense/81 (May 1981), 22-26.

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